PATENT ABSTRACTS OF JAPAN

(11)Publication number : 2002-258329
(43)Date of publication of application : 11.09.2002

(51)Int.Cl. G02F 1/17

(21)Application number : 2001-053577
(22)Date of filing : 28.02.2001

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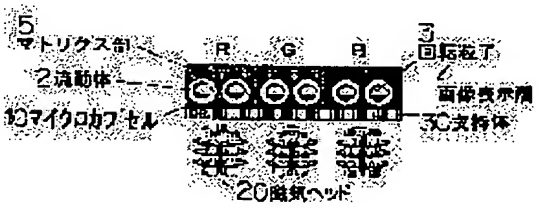
(54) COLOR DISPLAY METHOD, COLOR DISPLAY SHEET, COLOR DISPLAY DEVICE AND METHOD OF MANUFACTURING FOR THE SAME

(57)Abstract:
PROBLEM TO BE SOLVED: To realize a color display without complicating the constitution with respect to a monochromatic display in a method of making image display by changing the light reflectivity of particles in an image display layer.
SOLUTION: The rotary particles 3 which are color coded to two light reflective and/light absorptive colors, such as white/black are rotationally controlled by magnetic means (a magnetic head 20) in respective pixel units, by which writing or/and erasing are performed. The image display layers 4 corresponding to the respective pixels have matrix sections 5 colored to different colors, making the color display possible. In such a case, the rotary particles 3 are included together with fluid 2 into microcapsules 10, by which the rotary particles 3 made rotatable.



LEGAL STATUS

[Date of request for examination]

[Date of sending the examiner's decision of rejection]

[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]

[Date of final disposal for application]

[Patent number]

[Date of registration]

[Number of appeal against examiner's decision of rejection]

[Date of requesting appeal against examiner's decision of rejection]

(19)日本国特許庁（ＪＰ）　(12)公開特許公報（Ａ）　(11)特許出願公開番号
特開2002－258329
（P2002－258329A）
(43)公開日　平成14年９月11日(2002.9.11)

(51)Int.Cl.⁷	識別記号	ＦＩ	ﾃｰﾏｺｰﾄﾞ(参考)
Ｇ０２Ｆ　1/17		Ｇ０２Ｆ　1/17	

審査請求　未請求　請求項の数12　ＯＬ　（全８頁）

(21)出願番号　特願2001－53577(P2001－53577)

(22)出願日　平成13年２月28日(2001.2.28)

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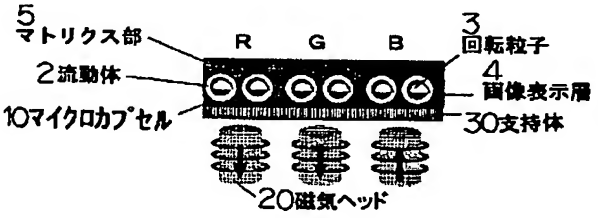
(54)【発明の名称】　カラー表示方法、カラー表示シート、カラー表示装置、およびこれらの製造方法

(57)【要約】
【課題】　画像表示層中の粒子の光反射率を変化させることにより画像表示を行なう方法において、モノクロ表示に対して構成を複雑化せずにカラー表示を実現すること。
【解決手段】　白／黒などの光反射性／光吸収性の２色に色分けられた回転粒子３を各画素単位で磁気的手段（磁気ヘッド２０）により回転制御することによって書き込み、または／および消去を行う。各画素に対応した画像表示層４は、異なる色に着色されたマトリクス部５を持っており、カラー表示が可能となる。この場合、回転粒子３を流動体２と共にマイクロカプセル１０中に内包し、回転粒子３が回転できる状態にする。



1

【特許請求の範囲】

【請求項１】　画像表示層中の粒子の光反射率を変化させることにより画像表示を行なう方法において、画像表示層を着色してカラー表示を行なうことを特徴とするカラー表示方法。

【請求項２】　請求項１に記載のカラー表示方法において、画像表示層の色が各画素単位でＲ、Ｇ、Ｂの三種類にそれぞれパターニング配置され、各画素単位でこれらの光反射率を制御することにより、カラー表示を行なうことを特徴とするカラー表示方法。

【請求項３】　請求項１に記載のカラー表示方法において、画像表示層中の光反射率を変化させる粒子が、マイクロカプセル中に内包されており、これらを画像表示層として配列し固定しているマトリクス部が着色されていることを特徴とするカラー表示方法。

【請求項４】　請求項１に記載のカラー表示方法において、画像表示層中の光反射率を変化させる粒子が、画像表示層中の微小空孔内に保持されており、画像表示層を形成しているマトリクス部が着色されていることを特徴とするカラー表示方法。

【請求項５】　請求項１ないし４のいずれか１項に記載のカラー表示方法において、画像表示層中の粒子の光反射率を変化させる手段が2色に色分けされた回転可能な粒子を回転させる方法であることを特徴とするカラー表示方法。

【請求項６】　請求項５に記載のカラー表示方法において、粒子の回転制御手段が、磁気的方法であることを特徴とするカラー表示方法。

【請求項７】　光反射率を変化させうる粒子を含み、着色した画像表示層を有し、前記請求項１の方法でカラー表示を行なうことを特徴とするカラー表示シート。

【請求項８】　光反射率を変化させうる粒子を含み、着色した画像表示層を有し、粒子の光学特性を変化させて書き込み、または／および消去を行なう手段を具備したことを特徴とするカラー表示装置。

【請求項９】　請求項７に記載のカラー表示シートを製造する方法であって、画像表示層を着色するに際し、色素を含有したフォトレジストを用いたフォトリソグラフィー法により、異なる色の画像表示層をパターニング配置することを特徴とするカラー表示装置の製造方法。

【請求項１０】　請求項８に記載のカラー表示装置を製造する方法であって、画像表示層を着色するに際し、色素を含有したフォトレジストを用いたフォトリソグラフィー法により、異なる色の画像表示層をパターニング配置することを特徴とするカラー表示装置の製造方法。

【請求項１１】　請求項７に記載のカラー表示シートを製造する方法であって、画像表示層を着色するに際し、画像表示層形成後にインクジェット方式によりパターニング着色することを特徴とするカラー表示シートの製造方法。

2

【請求項１２】　請求項８に記載のカラー表示装置を製造する方法であって、画像表示層を着色するに際し、画像表示層形成後にインクジェット方式によりパターニング着色することを特徴とするカラー表示装置の製造方法。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は、カラー表示方法、カラー表示シート、カラー表示装置、およびこれらの製造方法に関するものである。

【０００２】

【従来の技術】情報を表示する表示装置、ディスプレイとしては、その表示品質、経済性の観点から現在でもＣＲＴがその主流であるが、小型、軽量、低消費電力などを考慮して、種々のフラットパネルディスプレイが研究開発、実用化されている。これらの例として、プラズマディスプレイ（ＰＤＰ）、エレクトロルミネッセンスディスプレイ（ＥＬＤ）、蛍光表示管（ＶＦＤ）、発光ダイオード（ＬＥＤ）などの発光型ディスプレイ、そして液晶ディスプレイ（ＬＣＤ）などの受光型ディスプレイが挙げられる。これらの応用分野で主流となるＯＡ分野においては、これまで印刷物という媒体に慣れ親しんできたため、ちらつき等による目に疲労の少ないディスプレイが望まれるところだが、現状ではＣＲＴを始めとする発光型ディスプレイではこの点を解決するのは難しい。その点、受光型のＬＣＤはこの点で有利であり、さらに低消費電力などのメリットもあるが、視野角依存性、温度依存性などの特有のデメリットもあるのが実状である。そこで、受光型ディスプレイでも、マイクロカプセルからなる画像表示層を有し、磁気的又は電気的作用により画素単位で光反射率を変化させることにより画像表示を行なう方法、たとえば、電気泳動ディスプレイ、磁気泳動ディスプレイ、分散粒子配向型ディスプレイ、電気的、または磁気的手段を用いた粒子回転型ディスプレイなどが提案されてきた。しかし、これらは、現状では、白黒の単色表示だけであり、前記ＣＲＴ、ＬＣＤに比べてカラー表示が実用化されていないという大きな問題があった。このため、特開平10-232630号公報では表示層上に2色以上のカラーフィルターを配置してカラー表示を行なっているが、これはカラーフィルターを用いることによるコストアップが考えられ、さらにカラーフィルター層が新たに加わることにより層構成が複雑になり、作製工程が増えるだけでなく、表示特性（見易さ）にも影響し、さらに表示層上部からの書き込み消去の際にも不利となり、実用的ではない。

【０００３】

【発明が解決しようとする課題】従って本発明の目的は、画像表示層中の粒子の光反射率を変化させることにより画像表示を行なう方法において、モノクロ表示に対して構成を複雑化せずにカラー表示を実現することであ

る。

【０００４】

【課題を解決するための手段】画像表示層中の粒子の光反射率を変化させることにより画像表示を行なう方法において、画像表示層を着色してカラー表示を行なえば、従来のモノクロ表示と同等な構成でカラー表示を行なう方法を見い出した。本発明では、画像表示層をＲ、Ｇ、Ｂの３種類に、それぞれ周期的に配置し、各画素単位で光学特性を制御することにより、原理的にフルカラーが可能となる。ここで、画素とは、書き込み／消去制御可能な最小単位である。特に、画像表示層中の光反射率を変化させる粒子が、マイクロカプセル中に内包されており、これらを画像表示層として配列し固定しているマトリクス部が着色されている場合、画像表示層中の光反射率を変化させる粒子が、画像表示層中の微小空孔内に保持されており、画像表示層を形成しているマトリクス部が着色されている場合には効果的である。また、カラー表示においては、白色光を分光するため明るさの低下が起こるが、その影響の最も少ない粒子回転法、すなわち、粒子の光反射率を変化させる手段が2色に色分けされた回転可能な粒子を回転させる方法が好ましい。この場合、粒子の回転制御手段は、磁気的方法が好ましい。そして、このような表示方法を用いたカラー表示シート、さらに書き込み、または／および消去可能な手段を具備したカラー表示装置を提案するものである。さらに、画像表示層の着色方法としては、画像表示層形成の際に、色素を含有したフォトレジストを用いたフォトリソグラフィー法により異なる色の画像表示層をパターニング配置する方法、画像表示層形成後にインクジェット方式によりパターニング着色する方法が特に好ましいことを見い出した。

【０００５】請求項１の発明は、画像表示層中の粒子の光反射率を変化させることにより画像表示を行なう方法において、画像表示層を着色してカラー表示を行なうことを特徴とするカラー表示方法である。請求項２の発明は、請求項１に記載のカラー表示方法において、画像表示層の色が各画素単位でＲ、Ｇ、Ｂの三種類にそれぞれパターニング配置され、各画素単位でこれらの光反射率を制御することにより、カラー表示を行なうことを特徴とするカラー表示方法である。請求項３の発明は、請求項１に記載のカラー表示方法において、画像表示層中の光反射率を変化させる粒子が、マイクロカプセル中に内包されており、これらを画像表示層として配列し固定しているマトリクス部が着色されていることを特徴とするカラー表示方法である。請求項４の発明は、請求項１に記載のカラー表示方法において、画像表示層中の光反射率を変化させる粒子が、画像表示層中の微小空孔内に保持されており、画像表示層を形成しているマトリクス部が着色されていることを特徴とするカラー表示方法である。請求項５の発明は、請求項１ないし４のいずれか１項に記載のカラー表示方法において、画像表示層中の粒子の光反射率を変化させる手段が2色に色分けされた回転可能な粒子を回転させる方法であることを特徴とするカラー表示方法である。請求項６の発明は、請求項５に記載のカラー表示方法において、粒子の回転制御手段が、磁気的方法であることを特徴とするカラー表示方法である。請求項７の発明は、光反射率を変化させうる粒子を含み、着色した画像表示層を有し、請求項１の方法でカラー表示を行なうカラー表示シートである。請求項８の発明は、光反射率を変化させうる粒子を含み、着色した画像表示層を有し、粒子の光学特性を変化させて書き込み、または／および消去を行なう手段を具備したことを特徴とするカラー表示装置である。請求項９、請求項１０の発明はそれぞれ、請求項７、請求項８において画像表示層の着色方法が、画像表示層形成の際に、色素を含有したフォトレジストを用いたフォトリソグラフィー法により、異なる色の画像表示層をパターニング配置する方法であることを特徴とするカラー表示シート、およびカラー表示装置の製造方法である。請求項１１、請求項１２の発明はそれぞれ、請求項７、請求項８において画像表示層の着色方法が、画像表示層形成後にインクジェット方式によりパターニング着色する方法であることを特徴とするカラー表示シート、およびカラー表示装置の製造方法である。

【０００６】

【発明の実施の形態】本発明の実施の形態について説明する。前述の表示方法のうち、まず、電気泳動法について述べる。光吸収性、または光反射性の微粒子を分散した液体をマイクロカプセル中に内包し、または、そのまま画像表示層中に封入し、固液界面での電荷の授受により電気二重層が形成され、粒子は正または負に帯電し、これに電界を加えると、粒子は電界の方向に応じて泳動するため、各画素ごとに表示層上部の明暗のコントラストをつけることにより画像を形成するものである。

【０００７】磁気泳動法は、光吸収性の磁性体微粒子と光反射性の非磁性微粒子を分散した液体をマイクロカプセル中に内包し、または、そのまま画像表示層中に封入し、磁界を加えると磁性体微粒子が吸引され、各画素ごとに表示層上部の明暗のコントラストをつけることにより画像を形成するものである。分散粒子配向法は、偏平性などの形状異方性をもつ磁性体粒子の分散液をマイクロカプセル中に内包し、または、そのまま画像表示層中に封入し、磁界を加えると形状異方性をもつ磁性体粒子の向きに応じた光の反射、散乱、吸収が起こり、各画素ごとに表示層上部の明暗のコントラストをつけることにより画像を形成するものである。

【０００８】粒子回転法は、半分ずつに色分けされた光反射率の異なる部分を持った回転粒子を磁気的、または電気的手段などによって回転制御して、各画素ごとに表示層上部の明暗のコントラストをつけることにより画像

を形成するものである。本発明では特にカラー化による明るさの低下の影響が最も少ない方式として粒子回転法が効果的である。

【０００９】従って、以下、粒子回転法について詳細に説明する。磁気的手段による粒子回転ディスプレイにおける本発明でのカラー表示方法の一例を図１、図２に示した。両者とも前述のように、白／黒などの光反射性／光吸収性の2色に色分けられた回転粒子３を各画素単位で磁気的手段（磁気ヘッド２０）により回転制御することによって書き込み、または／および消去を行なうもので、この際、各画素に対応した画像表示層４は、異なる色に着色されたマトリクス部５を持っており、カラー表示が可能となる。この場合、図１のように、回転粒子３を流動体２と共にマイクロカプセル１０中に内包したり、図2のように、画像表示層４中の微小空孔部（空孔６）に回転粒子３を閉じ込めて粒子が回転できる状態にすることが必要である。この磁気回転粒子法では、モノクロ表示の際の回転粒子をそのまま用いることができ、構成を複雑化せずにカラー表示を実現することができる。画像表示層の色をＲＧＢの3種類とすると、Ｒ、Ｇ、Ｂ、黒はそのまま表現でき、隣り合うＲＧＢを全て表示すると混色により白が表現でき、また、ＲＧＢの組み合わせで中間色の表現も可能になる。ただし、階調については、回転具合によるものでは難しく、画素を小さくして面積階調を行なうのが現実的である。なお、図１、２において符号３０は支持体である。

【００１０】図１に示した回転粒子を内包するマイクロカプセルは、図３に示したように外殻１とその中に流動体２と2色に色分けられた回転粒子３から構成されており、カプセル内で回転粒子が自由に回転できるようになっている。これらの大きさは、表示装置、および表示画素の大きさ（解像度）、光の散乱、製造のし易さなどとも関係するが、１～1000μｍ程度が実用的である。回転粒子は磁性体を含んでおり、2色に色分けされた一方がＮ極、他方がＳ極になるように着磁されて永久磁石となっている。回転粒子は、球状の磁性体粒子、またはポリスチレン、ポリエチレン等の樹脂にマグネタイト、フェライトなどの鉄、コバルト、ニッケル等の磁性体を含有させた球状粒子などであり、粒子の回転、停止の制御が行ない易い形態、色分け、製造し易いものが好ましく、全てが均一な形状、大きさのものが望まれるため、実質的には球状の形態が好ましい。さらに比重、化学的安定性なども重要である。特に、磁性体／樹脂系粒子は、これらを混練後、粉砕、または磁性体粒子を分散したモノマーを乳化重合、懸濁重合、分散重合等の方法を用いて作製することができる。回転粒子を光反射性、光吸収性に色分けするには、二酸化チタンなどの白色系の色素カーボンなどの黒色物を溶媒、必要に応じてバインダー樹脂に分散し、スプレーなどの塗布、メッキなどの電気化学的方法、または前記色素、Au、Ag、Alなどの金属をスパッタ、蒸着などの方法などにより着色する。また2色に塗り分けるには、非着色面を接着剤、樹脂層に埋め込み固定したり、着色粒子と比重を調節した液体中に浮かべるなどの方法により、着色面にのみ着色を行なう。磁性粒子の場合には、磁性体の色がほとんど黒色であることから、2色のうち、一方に黒を用いる場合には、もう一方に、白を着色するだけで、2色に色分けできるので好都合である。本発明では、画像表示層を形成するマトリクス部を着色するため、上記回転粒子は白黒表示で用いたものがそのまま使用できる。

【００１１】次にマイクロカプセルの外殻を構成する材料としては、アクリル系、メタクリル系、ポリエステル、ポリスチレン、ポリウレア、ポリアミド、エポキシなど一般的な樹脂を単独、または混合してが使用できる。マイクロカプセルの製造方法としては、回転粒子を分散させたエマルジョンの内側と外側の両方からモノマーを供給する界面重合法、回転粒子を分散させたエマルジョンの内相、あるいは外相の一方からモノマーを供給するin-situ法、その他公知のマイクロカプセル化技術が用いられる。マイクロカプセルの外殻は、ある程度の押し圧に耐える機械的強度、透明性、化学的安定性などの特性が求められ、必要に応じて、各種樹脂などで表面を覆うなどの表面処理などにより補強することも可能である。マイクロカプセル内に含有させる流動体は、回転粒子の回転をスムーズにするための潤滑作用が最も求められ、水、油、アルコール等の液体が挙げられる。

【００１２】このようにして作製したマイクロカプセルを配列し、各画素単位で異なる色のマトリクスを持った画像表示層を形成するわけだが、この表示層の形成方法について説明する。

【００１３】まず、顔料、染料などの色素を含有した着色フォトレジスト中にマイクロカプセルを分散して用いたフォトリソグラフィー法が好ましい方法として挙げられる。この方法は、図４に示したように、たとえばマイクロカプセルを分散させたＲに着色されたフォトレジストを塗布、乾燥、露光、現像の一連のフォトリソプロセスにより、所定の画素に配置固定する。続いて、同様にＧに着色されたフォトレジスト、Ｂに着色されたフォトレジストを用いて、マイクロカプセルを所定の画素に配置固定することにより、ＲＧＢにパターニングされたマトリクス部を持った画像表示層が形成できる。この際、画像表示層のマトリクス部として残るフォトレジスト層の厚みやフォトレジスト中の色素の含有量などにより色特性等を制御できる。これらに用いるフォトレジストとしては、たとえば、アクリレート樹脂にベンゾフェノン類、アントラキノン類などの光重合開始剤を含有したネガ型レジスト、ノボラック型フェノール樹脂にo-キノンジアジドのエステル化物を含有したポジ型フォトレジストなどが挙げられるが特に限定されるものではなく、マイクロカプセルの分散性、それらを固定するための接着

性、画像表示層となった時の機械的耐久性等が優れていれば良い。また表示シートとして用いる場合には可とう性などの特性が求められる。

【００１４】これらに着色のために含有させる色素としては、主に三原色の分光特性を有する色素が好ましく、ペリレン顔料、レーキ顔料、アゾ系顔料、キナクリドン系顔料、アントラキノン系、金属置換フタロシアニン系顔料、ハロゲン多置換フタロシアニン系顔料などの有機顔料、酸化チタン、酸化鉄、コバルト紫、コバルトブルーなどの無機顔料が挙げられる。

【００１５】その他、好ましい方法としては、図５に示したように、画像表示層を形成した後、インクジェット方式により画像表示層マトリクス部を着色パターニングする方法が挙げられる。この方法では、まず最初に、光硬化性樹脂（フォトレジスト）、熱硬化性樹脂、一般的なバインダー樹脂溶液を塗布乾燥させて、必要に応じて光、または熱により樹脂部を硬化させることにより、マイクロカプセルとそれらの間を埋めるマトリクス部からなる画像表示層を形成する。マトリクス部を形成するこれらの樹脂は、特に限定されるものではないが、前述の接着性、機械的強度、可とう性などの他に、インクジェット方式を考慮して、インク受容層となることから、インク受容能があり、ドット再現性に優れ、また透明性に優れていることが望まれる。このような観点からは、水溶性、親水性の各種樹脂が好ましく、たとえば、ポリビニルアルコール、ポリエチレンオキシド、ポリプロピレンオキシド、ポリビニルピロリドン、スチレン・無水マレイン酸共重合体の加水分解物またはその水溶性塩、メチルセルロース、ヒドロキシメチルセルロース、ヒドロキシプロピルセルロース、カルボキシメチルセルロース、またはその水溶性塩、ポリアクリル酸またはその水溶性塩などが挙げられる。画像表示層を形成後、各色、たとえばＲＧＢのインクをインクジェット方式により付与する。インクジェット方式としては、熱エネルギー、機械エネルギーなどによる方式などが挙げられるが、特に限定されるものではない。また、使用するインクについても、一般にインクジェット用として用いられるものが使用できる。

【００１６】その他のマイクロカプセルを配列し、各画素単位で異なる色のマトリクスを持った画像表示層を形成する方法としては、電着法などの電気化学的方法などが挙げられる。この場合、いずれも画像表示層を形成する部分に電極となる導電層が必要となる。従って、各画素間では、導通しないような電極構成が必要となるが、マイクロカプセルのパターニング配置の工程は容易にできる。また、後述する電気的手段による表示方法では、表示駆動に電極が必要となるため、そのままそれが表示駆動用の電極として用いることができる。

【００１７】回転粒子は上記説明のようにマイクロカプセルに内包させるだけでなく、図２に示したように、画像表示層中の微小空孔内に閉じ込めて回転させることもできる。このような実施形態を行なうには、たとえば、シリコンゴムのような弾性体中に回転粒子を埋め込み、シリコンオイルのような流動体をシリコンゴム内に浸入させることにより、シリコンゴムが膨潤し回転粒子とシリコンゴム間に隙間ができそこにシリコンオイルが満たされて、図2のような構造ができあがる。なお、シリコンゴム中に回転粒子を埋め込むには、たとえば、架橋前の液状のシリコンゴム中に回転粒子を分散し、これを塗布して膜状として加硫などにより架橋反応を行なうことにより達成できる。

【００１８】図２の構造の場合、マトリクス部を着色するには前記説明した方法の中ではインクジェット方式が好適である。すなわち、図2の構造の画像表示層を形成した後、図1の構造の場合と同様にインクジェット方式により画像表示層マトリクス部を着色パターニングする。なお、この際、マトリクス部をそのままインク受容層に用いてもよいし、必要に応じて前述の水溶性、親水性の各種樹脂層をインク受容層として設けてもよい。

【００１９】次に、電気的手段による粒子回転ディスプレイのカラー表示方法の一例を図６、７に示した。画像表示層の構成、形成方法は磁気的手段の場合と同様であり、磁気的手段と異なる点は、回転粒子が２つの磁極を持った磁性体ではなく、2色に色分けされた部分が異なる帯電特性を持った粒子であり、これは回転粒子表面を半球ずつ異なる物質で覆うことによって作製できる。つまり、2色に色分けする際に、通常、表面を色の異なる物質で覆うわけであり、そのままそれが異なる帯電特性を持った部分ができることになる。ただし、実際には、それが粒子回転に寄与できるとは限らないため、帯電特性の大きく異なるような材料を添加することにより粒子回転が可能となる。これには、帯電制御の容易さから、ワックス状物質が良く用いられる。これらの例としては、ステアリン酸、パルミチン酸、ラウリン酸などの高級脂肪酸類、ステアリン酸アルミニウムなどの高級脂肪酸金属塩類、高級脂肪酸誘導体類、カルナバワックス、パラフィンワックスなどのワックス類、ポリエチレン、ポリプロピレン、エチレン－酢酸ビニル共重合体等が挙げられる。また、図6のマイクロカプセル内の流動体、または図7の微小空孔内を満たした流動体は、透明なシリコンオイルなどの誘電体を用いる。さらに、電気的手段の場合、表示層の上下を画素単位にパターニングされた電極が必要となる。この際、表示層の上部は透明電極であることが必要であるが、下部は特にそのような限定はない。むしろ、、光反射率の高い材料を用いることにより、明るさを向上できる。上部に用いる透明電極としては、In_2O_3、SnO_2、ZnO、CdO、TiO_2、In_2O_3-Sn、SnO_2-Sbなどの酸化物半導体薄膜等公知のものが用いられる。また、表示層下部に用いられる電極としては、上記透明電極のほかに、Au、Ag、Cu、Pt、Alなど光沢のある金属

などが挙げられるが特に限定されるものではない。

【００２０】以上、表示原理、表示層の構成、作製方法について述べてきたが、次に、これらの表示層を用いたカラー表示シート、およびカラー表示装置について説明する。図８、９にカラー表示シートの構成図の一例を示した。

【００２１】図８の磁気的手段による表示の場合には、前述の表示層を挟んで上側に保護層、下側に支持体、さらに必要に応じてメモリー層を組み合わせた構成が提案できる。保護層は、磁気ヘッド、さらに実使用における様々な押し圧、摩擦に対して耐久性があり、透明性が高く、安定なものが用いられ、たとえば、樹脂を塗布したり、樹脂フィルム、樹脂プレートを張り合わせて用い、上部から書き込み／消去を行なう場合、視認性の観点からは薄い方が好ましいため、前記機械的強度との兼ね合いで、10～1000μｍ程度が好ましい。支持体はポリエチレンテレフタレート、ポリカーボネート、ポリエチレンなどの樹脂フィルム、樹脂プレートを用いることができるが、特に限定されるものではなく、厚みは書き込み／消去を行なうことを考慮すると薄い方が好ましい。一方、シートとしての扱い易さを考慮するとあまり薄すぎるのも問題であり、10～1000μｍ程度が好ましい。メモリー層は主に半硬質磁性材料からできており、磁気的手段によって書き込んだ表示情報を書き込みの磁界を切っても、また使用環境にある程度の磁場が存在しても、メモリー層の磁化によって保持するためのものであり、厚みは用いる磁性材料、作製方法にもよるが、0.1～10μｍ程度が好ましい。メモリー層がない場合には、必要に応じて表示情報を保持するために、たとえば、粒子回転のしきい値を設定するなどの工夫が考えられる。

【００２２】図９の電気的手段による表示の場合は、表示層の上部の保護層と下部の支持体から成り、表示情報の保持には、必要に応じて粒子回転のしきい値を設定するなどの手段により達成するものである。この他の実施形態としては、表示層上部、または／および下部の電極をシート部内に構成するなどの形態も考えられる。表示シートの場合、書き込み／消去をする部分とは切り離して、表示部分のみを独立させることが可能である。従って、各種構成材料をプラスチックフィルムなどのフレキシブルな材料を用いることにより、軽く紙のように取り扱える表示手段となる。

【００２３】これら表示シートに画像情報を入力または消去する手段としては、磁気的手段では、表示層下部から、1次元、または2次元の磁気ヘッドアレイを用いたり、一部分の追記／消去には、表示層上部から磁気ペンなどにより可能となる。なお、1次元磁気ヘッドアレイを用いる場合には、主走査方向に移動する手段を用いて表示領域全体の画像を記録する。また、電気的手段では、各画素に対応した表示層上下を電極で挟んで電界を印加するなどの方法である。表示シートは、このような書き込み／消去手段と切り離されている場合には、これらと位置合わせして接続し、書き込み／消去を行なうことになる。

【００２４】本発明のもう一つの実施形態であるカラー表示装置は、図10、11に示したように、表示部と書き込み／消去を行なう入力部が一体となっているものである。前述の表示シートが入力部から切り離して紙のような表示媒体として扱えたのに対して、この表示装置の場合は、設置場所を固定したディスプレーとして使用することになる。表示シートの場合とはことなり、表示部を切り離すことがないため、表示部と書き込み／消去を行なう入力部の位置合わせを行なう必要がなく、カラー化にはより有利となる。

【００２５】

【実施例】[実施例１]磁性体としてフェライト微粒子を含有した粒径約６μｍのポリマー球状粒子を公知の懸濁重合法にて作製した。ガラス基板上にポリビニリアルコールを粘着層として塗布し、この上に上記磁性体含有ポリマー球状粒子を敷き詰めて固定して、上からAlを蒸着することにより、粒子上部にAlを付着させ、続いて1KGの電磁石で着磁を行ない、粒子を粘着層から剥がし、白／黒2色に色分けし、着磁した粒子を作製した。次に、公知のゼラチンとアラビアゴムのコアセルベーション法にてこれら回転粒子とシリコンオイルを内包したマイクロカプセルを作製した。次に、Ｒのカラーレジスト溶液にこれらのマイクロカプセルを分散して、スピンコート法にて100μｍのポリカーボネートフィルム上に塗布して、フォトリソグラフィー法によりＲのマトリクスからなる画像表示層を所定の位置にパターニング配置した。続いて、同様にして、Ｇのマトリクスからなる画像表示層を配置し、最後にＢのマトリクスからなる画像表示層を配置して、厚さ約15μｍで、100×100μｍの画素に周期的にマトリクスの色が異なる画像表示層を形成した。このような画像表示層上に、熱硬化型のアクリル樹脂を塗付して、150℃20分ベークして100μｍの保護層を形成し、カラー表示用シートを作製した。このカラー表示シートを二次元磁気ヘッドアレイに密着して書き込み／消去を行なったところ、混色によるカラー表示が可能であった。

【００２６】[実施例２]サンワックスＥ-200（三洋化成工業製）とカーボンブラックを混練し、スプレードライヤー法にて造粒し、分級して約15μｍの黒色粒子を作製し、これを実施例１と同様な方法にて、半球部に白色を着色して、白／黒2色に色分けされた粒子を作製した。これらの粒子をニ液性RTVゴムKE103／Cat103（信越化学工業）中に混合分散し、110μｍピッチ（Line 100μSpace 10μｍ）のストライプ状に透明導電膜をパターニングしたガラス基板上に塗布し、25℃にて18時間放置して硬化させて、約100μｍの回転粒子を含有したシリコンゴム層を形成した。これをシリコンオイル中に浸漬して

11

24時間放置して取り出した後、インクジェット方式により、画像表示層のマトリクス部をＲＧＢにパターニング着色した。このような表示層上に、110μｍピッチ（Line 100μSpace 10μｍ）のストライプ状に透明導電膜をパターニングしたガラス基板を画像表示層上下の電極と格子状になるように張り合わせて、カラー表示装置を作製した。このカラー表示装置を表示層上下の電極にて電界を加えて、書き込み／消去を行なったところ、混色によるカラー表示が可能であった。

【００２７】

【発明の効果】請求項１の発明によれば、LCDに比べて広視野角、低コストで、構成を複雑化せずにカラー表示を行なうことが可能となった。請求項２の発明によれば、従来よりも明るさ、コントラストなどの視認性が優れたフルカラー表示が可能となった。請求項３、４の発明によれば、画像表示に関わる粒子間の凝集を防ぎ、制御性の容易なカラー表示が可能となった。請求項５の発明によれば、明るさ、コントラストの点で有利なカラー表示が可能となった。請求項６の発明によれば、構成が簡単であるため、作製が容易であったり、視認性が優れたカラー表示が可能となった。請求項７の発明によれば、広視野角で、さらにモノクロ表示と同様な構成のペーパーライクなカラー表示シートができた。請求項８の発明によれば、広視野角で、さらにモノクロ表示と同様な構成のカラー表示装置ができた。請求項９～１２の発明によれば、低コストで作製できるカラー表示シート、カラー表示装置の製造方法が提供できた。

【図面の簡単な説明】

【図１】磁気粒子回転ディスプレイのカラー表示方法（マイクロカプセル使用）を説明するための図である。

12

【図２】磁気粒子回転ディスプレイのカラー表示方法（微小空孔使用）を説明するための図である。

【図３】マイクロカプセル構成を説明するための図である。

【図４】画像表示層形成方法の一例（フォトリソ法）を説明するための図である。

【図５】画像表示層形成方法の別例（インクジェット法）を説明するための図である。

【図６】磁気粒子回転ディスプレイのカラー表示方法（マイクロカプセル使用）を説明するための図である。

【図７】磁気粒子回転ディスプレイのカラー表示方法（微小空孔使用）を説明するための図である。

【図８】カラー表示シートの構成例（磁気的手段）を説明するための図である。

【図９】カラー表示シートの構成例（電気的手段）を説明するための図である。

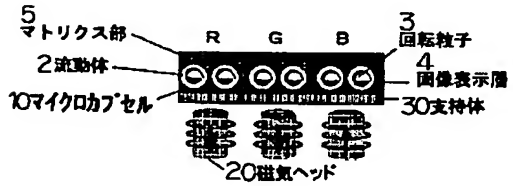
【図１０】カラー表示装置の構成例（磁気的手法）を説明するための図である。

【図１１】カラー表示装置の構成例（電気的手法）を説明するための図である。

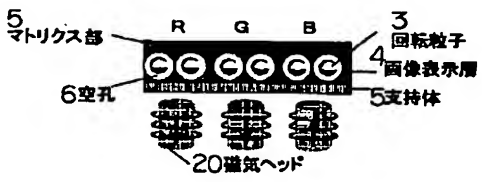
【符号の説明】

1　外殻
2　流動体
3　回転粒子
4　画像表示層
5　マトリクス部
6　空孔
１０　マイクロカプセル
２０　磁気ヘッド
３０　支持体

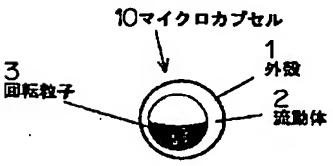
【図１】



【図２】



【図３】



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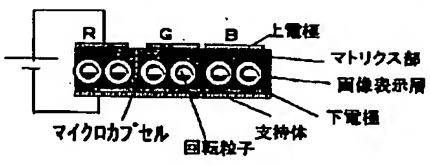

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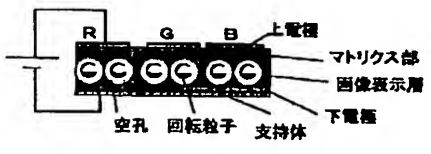
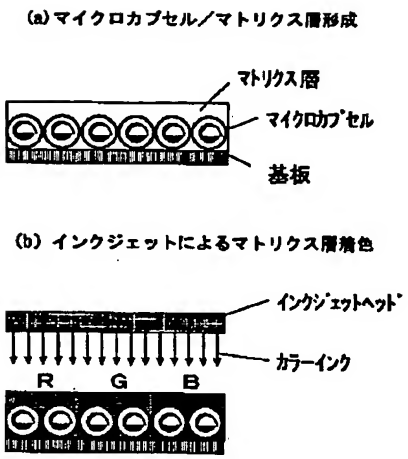


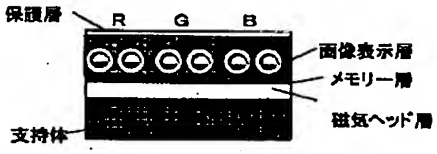
【図４】

【図５】

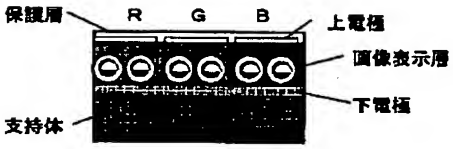


【図８】

【図１０】



【図１１】



【図９】

* NOTICES *

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2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

CLAIMS

[Claim(s)]
[Claim 1] The color display approach characterized by coloring an image display layer and performing color display in the approach of performing image display by changing the rate of a light reflex of the particle in an image display layer.
[Claim 2] The color display approach characterized by performing color display when patterning arrangement is carried out in each pixel unit at three kinds, R, G, and B, respectively and the color of an image display layer controls these rates of a light reflex by each pixel unit in the color display approach according to claim 1.
[Claim 3] The color display approach which the endocyst of the particle to which the rate of a light reflex in an image display layer is changed is carried out into the microcapsule, and is characterized by coloring the matrix section which arranges these as an image display layer and is fixed in the color display approach according to claim 1.
[Claim 4] The color display approach characterized by coloring the matrix section in which the particle to which the rate of a light reflex in an image display layer is changed is held in the minute hole in an image display layer, and forms the image display layer in the color display approach according to claim 1.
[Claim 5] The color display approach characterized by a means to change the rate of a light reflex of the particle in an image display layer being the approach of rotating the pivotable particle classified by two colors by color in the color display approach given in claim 1 thru/or any 1 term of 4.
[Claim 6] The color display approach that the roll control means of a particle is characterized by being the magnetic approach in the color display approach according to claim 5.
[Claim 7] The color display sheet characterized by having the colored image display layer including the particle in which the rate of a light reflex is changed and it deals, and performing color display by the approach of said claim 1.
[Claim 8] The electrochromatic display characterized by providing the means which has the colored image display layer including the particle in which the rate of a light reflex is changed and it deals, the optical property of a particle is changed, and writes in, or/and eliminates.
[Claim 9] The manufacture approach of the electrochromatic display characterized by carrying out patterning arrangement of the image display layer of a different color by the photolithography method using the photoresist which is the approach of manufacturing a color display sheet according to claim 7, faced coloring an image display layer, and contained coloring matter.
[Claim 10] The manufacture approach of the electrochromatic display characterized by carrying out patterning arrangement of the image display layer of a different color by the photolithography method using the photoresist which is the approach of manufacturing a electrochromatic display according to claim 8, faced coloring an image display layer, and contained coloring matter.
[Claim 11] The manufacture approach of the color display sheet characterized by being the approach of manufacturing a color display sheet according to claim 7, facing coloring an image display layer, and carrying out patterning coloring with an ink jet method after the image display stratification.
[Claim 12] The manufacture approach of the electrochromatic display characterized by being the

approach of manufacturing a electrochromatic display according to claim 8, facing coloring an image display layer, and carrying out patterning coloring with an ink jet method after the image display stratification.

[Translation done.]

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the color display approach, a color display sheet, electrochromatic displays, and these manufacture approaches.
[0002]
[Description of the Prior Art] As the indicating equipment which displays information, and a display, CRT takes into consideration small, a light weight, a low power, etc. for it, although current [the viewpoint of the display quality and economical efficiency to] is the mainstream, and various flat-panel displays are done [research and development in them] and put in practical use. As these examples, light-receiving mold displays, such as luminescence mold displays, such as a plasma display (PDP), an electroluminescence display (ELD), a fluorescent indicator tube (VFD), and a light emitting diode (LED), and a liquid crystal display (LCD), are mentioned. Since it got used to a medium called printed matter and has so far been familiar with it in OA field which becomes in use in these applicable fields, it is difficult but to solve this point in luminescence mold displays including CRT in the present condition the place where the eye by flicker etc. is expected little display of fatigue. In that respect, although LCD of a light-receiving mold is advantageous at this point and there are also merits, such as a low power, further, the actual condition is that there are also characteristic demerits, such as an angle-of-visibility dependency and temperature dependence. Then, it had the image display layer which a light-receiving mold display also becomes from a microcapsule, and magnetic or the method of performing image display, for example, an electrophoresis display, the magnetic migration display, the particulate material orientation mold display, the particle rotation mold display using electric or a magnetic means, etc. have been proposed by changing the rate of a light reflex per pixel by the electric action. However, in the present condition, these are only monochrome monochromatic specification and had the big problem that color display was not put in practical use compared with said CRT and LCD. For this reason, when the cost rise by this using a color filter although the color filter of two or more colors is arranged on a display layer in JP,10-232630,A and color display is performed can be considered and a color filter layer is newly added further, lamination becomes complicated, a making process not only increasing but a display property (conspicuousness) is influenced, and it becomes still more disadvantageous also in the case of write-in elimination from the display layer upper part, and is not practical.
[0003]
[Problem(s) to be Solved by the Invention] Therefore, the purpose of this invention is realizing color display, without complicating a configuration to a monochrome display in the approach of performing image display, by changing the rate of a light reflex of the particle in an image display layer.
[0004]
[Means for Solving the Problem] In the approach of performing image display by changing the rate of a light reflex of the particle in an image display layer, when coloring the image display layer and performing color display, the approach of performing color display with a configuration equivalent to the conventional monochrome display was found out. In this invention, full color **

becomes possible theoretically by arranging an image display layer periodically to three kinds, R, G, and B, respectively, and controlling an optical property by each pixel unit. here -- a pixel -- writing/elimination -- it is a controllable smallest unit. The endocyst of the particle to which the rate of a light reflex in an image display layer is changed especially is carried out into the microcapsule, and the particle to which the rate of a light reflex in an image display layer is changed when the matrix section which arranges these as an image display layer and is fixed is colored is held in the minute hole in an image display layer, and it is effective when the matrix section which forms the image display layer is colored. Moreover, in color display, although the fall of brightness takes place in order to carry out the spectrum of the white light, fewest particle rotation methods of the effect, i.e., the method of rotating the pivotable particle by which a means to change the rate of a light reflex of a particle was classified by two colors by color, are desirable. In this case, the roll control means of a particle has the desirable magnetic approach. And the color display sheet using such the method of presentation and the electrochromatic display which wrote in further or/and possesses an eliminable means are proposed. Furthermore, the approach of carrying out patterning arrangement of the image display layer of the color which changes as the coloring approach of an image display layer with photolithography methods using the photoresist which contained coloring matter on the occasion of the image display stratification, and especially the approach of carrying out patterning coloring with an ink jet method after the image display stratification found out the desirable thing.

[0005] Invention of claim 1 is the color display approach characterized by coloring an image display layer and performing color display in the approach of performing image display, by changing the rate of a light reflex of the particle in an image display layer. In the color display approach according to claim 1, invention of claim 2 is the color display approach characterized by performing color display, when patterning arrangement is carried out in each pixel unit at three kinds, R, G, and B, respectively and the color of an image display layer controls these rates of a light reflex by each pixel unit. Invention of claim 3 is the color display approach which the endocyst of the particle to which the rate of a light reflex in an image display layer is changed is carried out into the microcapsule, and is characterized by coloring the matrix section which arranges these as an image display layer and is fixed in the color display approach according to claim 1. Invention of claim 4 is the color display approach characterized by coloring the matrix section in which the particle to which the rate of a light reflex in an image display layer is changed is held in the minute hole in an image display layer, and forms the image display layer in the color display approach according to claim 1. Invention of claim 5 is the color display approach characterized by a means to change the rate of a light reflex of the particle in an image display layer being the approach of rotating the pivotable particle classified by two colors by color in the color display approach given in claim 1 thru/or any 1 term of 4. Invention of claim 6 is the color display approach that the roll control means of a particle is characterized by being the magnetic approach, in the color display approach according to claim 5. Invention of claim 7 is a color display sheet which has the colored image display layer including the particle in which the rate of a light reflex is changed and it deals, and performs color display by the approach of claim 1. Invention of claim 8 is a electrochromatic display characterized by providing the means which has the colored image display layer including the particle in which the rate of a light reflex is changed and it deals, the optical property of a particle is changed, and writes in, or/and eliminates. Invention of claim 9 and claim 10 is the manufacture approach of the color display sheet to which the coloring approach of an image display layer is characterized by being the approach of carrying out patterning arrangement of the image display layer of a different color in claim 7 and claim 8 by the photolithography method using the photoresist which contained coloring matter on the occasion of the image display stratification, respectively, and a electrochromatic display. Invention of claim 11 and claim 12 is the manufacture approach of the color display sheet characterized by the coloring approach of an image display layer being the approach of carrying out patterning coloring with an ink jet method after the image display stratification in claim 7 and claim 8, respectively, and a electrochromatic display.

[0006]

[Embodiment of the Invention] The gestalt of operation of this invention is explained. An

electrophoresis method is first described among the above-mentioned methods of presentation. The liquid which distributed the particle of light absorption nature or light reflex nature is connoted in a microcapsule. Or if enclose into an image display layer as it is, an electric double layer is formed of transfer of the charge in a solid-liquid interface, a particle is charged in forward or negative and electric field are added to this, in order that a particle may migrate according to the direction of electric field, An image is formed by giving the contrast of the light and darkness of the display layer upper part for every pixel.

[0007] The liquid which distributed the magnetic-substance particle of light absorption nature and the nonmagnetic particle of light reflex nature is connoted in a microcapsule, or it encloses into an image display layer as it is, if a field is added, a magnetic-substance particle will be attracted, and the magnetic migrating method forms an image by giving the contrast of the light and darkness of the display layer upper part for every pixel. The dispersion liquid of a magnetic-substance particle with shape anisotropy, such as flat nature, are connoted in a microcapsule, or it encloses into an image display layer as it is, if a field is added, reflection of the light according to the sense of a magnetic-substance particle with shape anisotropy, dispersion, and absorption will take place, and a particulate material orientation method forms an image by giving the contrast of the light and darkness of the display layer upper part for every pixel.

[0008] A particle rotation method is magnetic or a thing which forms an image by carrying out a roll control and giving the contrast of the light and darkness of the display layer upper part for every pixel with an electric means etc., about a rotation particle with the part from which the rate of a light reflex classified by by one half by color differs. A particle rotation method is effective as a method with least effect of a fall of the brightness according to colorization especially at this invention.

[0009] Therefore, a particle rotation method is hereafter explained to a detail. An example of the color display approach in this invention in the particle rotation display by the magnetic means was shown in drawing 1 and drawing 2 . When both do the roll control of the rotation particle 3 kicked by the color by the magnetic means (magnetic head 20) in each pixel unit as mentioned above to two colors of light reflex nature / light absorption nature, such as white/black, it writes in, or/and it eliminates, and in this case, the image display layer 4 corresponding to each pixel has the matrix section 5 colored a different color, and the color display of it becomes possible. In this case, it is required like drawing 1 to change into the condition that the rotation particle 3 is confined in the minute hole section in the image display layer 4 (hole 6), and a particle can be rotated like drawing 2 in connoting the rotation particle 3 in a microcapsule 10 with a fluid 2. By this magnetic rotation particle method, the rotation particle in the case of a monochrome display can be used as it is, and color display can be realized, without complicating a configuration. If the color of an image display layer is made into three kinds of RGB, R, G, B, and black can be expressed as it is, if all adjacent RGB is displayed, color mixture can express white, and the expression of neutral colors is also attained in the combination of RGB. However, about gradation, it is difficult and it is realistic to make a pixel small and to perform area gradation what is depended on rotation condition. in addition, drawing 1 R> -- in 1 and 2, a sign 30 is a base material.

[0010] The microcapsule which connotes the rotation particle shown in drawing 1 is constituted from a rotation particle 3 kicked by the color by a fluid 2 and two colors in it with the outer shell 1, as shown in drawing 3 , and a rotation particle can rotate it now freely within a capsule. Although such magnitude is related to the ease of carrying out of the magnitude (resolution) of a display and a display pixel, dispersion of light, and manufacture etc., its about 1-1000 micrometers are practical. The rotation particle contains the magnetic substance, it is magnetized so that it might be classified by two colors by color, while N pole and another side may become the south pole in them, and it serves as a permanent magnet. It is a spherical particle which made resin, such as a spherical magnetic-substance particle or polystyrene, and polyethylene, contain the magnetic substance, such as iron, such as magnetite and a ferrite, cobalt, and nickel, a rotation particle has the gestalt which rotation of a particle and control of a halt tend to perform, and the desirable thing which is classified by color and is easy to manufacture, and since a thing of a configuration with uniform all and magnitude is desired, its

spherical gestalt is substantially desirable. Specific gravity, chemical stability, etc. are still more important. Especially the magnetic substance / resin system particle can produce the monomer which distributed grinding or a magnetic-substance particle after kneading these using approaches, such as an emulsion polymerization, a suspension polymerization, and a distributed polymerization. In order to classify a rotation particle by color to light reflex nature and light absorption nature, black objects, such as coloring matter carbon of white systems, such as a titanium dioxide, are distributed to binder resin a solvent and if needed, and metals, such as electrochemical processes, such as spreading of a spray etc. and plating, or said coloring matter, and Au, Ag, aluminum, are colored by approaches, such as a spatter and vacuum evaporationo, etc. Moreover, in order to distinguish by different color with in two colors, embed a non-coloring field in adhesives and a resin layer, and it fixes, or is colored only a coloring side by floating into the liquid which adjusted a coloring particle and specific gravity etc. Since the color of the magnetic substance is almost black, when using black between two colors at one side in the case of a magnetic particle, since white is only colored another side and it can classify by color in two colors, it is convenient. In this invention, since the matrix section which forms an image display layer is colored, what was used by monochrome display can use the above-mentioned rotation particle as it is.

[0011] next -- as the ingredient which constitutes the outer shell of a microcapsule -- common resin, such as acrylic, an methacrylic system, polyester, polystyrene, poly urea, a polyamide, and epoxy, -- independence -- or it can mix and ******. As the manufacture approach of a microcapsule, the in-situ method which supplies a monomer from either the internal phase of an emulsion who distributed the interfacial polymerization which supplies a monomer, and a rotation particle, or an external phase, and other well-known microencapsulation techniques are used from both the inside of an emulsion which distributed the rotation particle, and an outside. Properties, such as a mechanical strength which, pushes and bears **, transparency, and chemical stability, are searched for, and the outer shell of a microcapsule can also be reinforced by surface treatment, such as covering a front face by various resin etc., etc. if needed. [a mechanical strength] A lubrication action for the fluid made to contain in a microcapsule to make rotation of a rotation particle smooth is called for most, and liquids, such as water, an oil, and alcohol, are mentioned.

[0012] Thus, the produced microcapsule is arranged, and although an image display layer with the matrix of a color which is different in each pixel unit is formed, the formation approach of this display layer is explained.

[0013] first, a pigment -- a color -- ** -- the photolithography method which distributed and used the microcapsule into the coloring photoresist containing coloring matter is mentioned as a desirable approach. This approach carries out arrangement immobilization of the photoresist colored R which distributed the microcapsule at a predetermined pixel according to a series of FOTORISO processes of spreading, desiccation, exposure, and development, as shown in drawing 4 . Then, an image display layer with the matrix section by which patterning was carried out to RGB can be formed by carrying out arrangement immobilization of the microcapsule at a predetermined pixel using the photoresist similarly colored G and the photoresist colored B. Under the present circumstances, a color property etc. is controllable by the thickness of the photoresist layer which remains as the matrix section of an image display layer, the content of the coloring matter in a photoresist, etc. It is not limited especially although the negative resist which contained photopolymerization initiators, such as benzophenones and anthraquinone, to acrylate resin, the positive type photoresist which contained the esterification object of o-quinone diazide in novolak mold phenol resin are mentioned as a photoresist used for these, for example, and the mechanical endurance when becoming an adhesive property for fixing the dispersibility of a microcapsule and them and an image display layer etc. should be just excellent. Moreover, properties, such as flexibility, are searched for when using as a display sheet.

[0014] The coloring matter which mainly has the spectral characteristic in three primary colors as coloring matter made to contain for coloring to these is desirable, and inorganic pigments, such as organic pigments, such as a perylene pigment, a lake pigment, azo pigment, the Quinacridone system pigment, an anthraquinone system, metal replacement phthalocyanine

pigment, and halogen multi-permutation phthalocyanine pigment, titanium oxide, ferrous oxide, cobalt purple, and cobalt blue, are mentioned.

[0015] In addition, as shown in drawing 5 , after forming an image display layer as a desirable approach, the approach of carrying out coloring patterning of the image display layer matrix section with an ink jet method is mentioned. The image display layer which consists of the matrix section which fills between a microcapsule and them by this approach by carrying out spreading desiccation of a photo-setting resin (photoresist), thermosetting resin, and the common binder resin solution, and stiffening the resin section with light or heat first if needed is formed. Although especially these resin that forms the matrix section is not limited, since it becomes an ink absorbing layer else [, such as the above-mentioned adhesive property, a mechanical strength, and flexibility,] in consideration of an ink jet method, for there to be ink competence, and to excel in dot repeatability, and to excel in transparency is desired. From such a viewpoint, the various resin of water solubility and a hydrophilic property is desirable, for example, the hydrolyzate of polyvinyl alcohol, polyethylene oxide, polypropylene oxide, a polyvinyl pyrrolidone, and a styrene maleic anhydride copolymer or its water-soluble salt, methyl cellulose, a hydroxymethyl cellulose, hydroxypropylcellulose, a carboxymethyl cellulose or its water-soluble salt, polyacrylic acid, or its water-soluble salt is mentioned. An ink jet method gives the ink of each color, for example, RGB, after forming an image display layer. Although the method by heat energy, mechanical energy, etc. is held as an ink jet method, it is not limited especially. Moreover, what is generally used as an object for ink jets can be used also about the ink to be used.

[0016] Other microcapsules are arranged and electrochemical processes, such as an electrodeposition process, etc. are mentioned as an approach of forming an image display layer with the matrix of a color which is different in each pixel unit. In this case, the conductive layer used as an electrode is needed for the part in which all form an image display layer. Therefore, although an electrode configuration which does not flow is needed between each pixel, the process of patterning arrangement of a microcapsule is made easily. Moreover, in the method of presentation by electric means to mention later, since an electrode is needed for a display drive, it can use as an electrode for a display drive as it is.

[0017] As shown in drawing 2 , it can shut up in the minute hole in an image display layer, and it not only carries out endocyst to a microcapsule like the above-mentioned explanation, but can also rotate a rotation particle. In order to perform such an operation gestalt, by embedding a rotation particle into an elastic body like silicone rubber, and making a fluid like a silicone oil permeate into silicone rubber, silicone rubber swells, a clearance is made between a rotation particle and silicone rubber, a silicone oil is filled there, and structure like drawing 2 is done. In addition, in order to embed a rotation particle into silicone rubber, a rotation particle is distributed in the liquefied silicone rubber before bridge formation, and it can attain by applying this and performing crosslinking reaction with vulcanization etc. as the shape of film.

[0018] In said explained approach, an ink jet method is suitable to color the matrix section in the case of the structure of drawing 2 . That is, after forming the image display layer of the structure of drawing 2, coloring patterning of the image display layer matrix section is carried out with an ink jet method like the case of the structure of drawing 1. In addition, in this case, the matrix section may be used for an ink absorbing layer as it is, and the various resin layers of the above-mentioned water solubility and a hydrophilic property may be prepared as an ink absorbing layer if needed.

[0019] Next, an example of the color display approach of the particle rotation display by the electric means was shown in drawing 6 and 7. The configuration of an image display layer and the formation approach are the same as that of the case of a magnetic means, a different point from a magnetic means is a particle with the electrification property that not the magnetic substance in which the rotation particle had two magnetic poles but the parts classified by two colors by color differ, and this can be produced by covering a rotation particle front face by matter different a semi-sphere every. That is, in case it classifies by color in two colors, a part with the electrification property that are a wrap reason by the matter by which colors differ a front face, and they usually differ as it is will be made. However, in fact, since it cannot necessarily contribute to particle rotation, particle rotation is attained by adding an ingredient which an

electrification property is large and differ. The wax-like matter is well used for this from the ease of electrification control. As these examples, waxes, such as higher-fatty-acid metal salts, such as higher fatty acids, such as stearin acid, a palmitic acid, and a lauric acid, and aluminum stearate, higher-fatty-acid derivatives, carnauba wax, and paraffin wax, polyethylene, polypropylene, an ethylene-vinylacetate copolymer, etc. are mentioned. Moreover, dielectrics, such as a transparent silicone oil, are used for the fluid in the microcapsule of drawing 6, or the fluid which filled the inside of the minute hole of drawing 7. Furthermore, in the case of an electric means, the electrode by which patterning was carried out per pixel in the upper and lower sides of a display layer is needed. Under the present circumstances, although the upper part of a display layer needs to be a transparent electrode, there is especially such [the lower part] no limitation. Brightness can be improved by using an ingredient with the high rate of a light reflex rather. As a transparent electrode used for the upper part, well-known things, such as oxide-semiconductor thin films, such as In 2O3; SnO2; ZnO, CdO and TiO2, In2O3-Sn, and SnO2-Sb, are used. Moreover, it is not limited especially although a metal with gloss other than the above-mentioned transparent electrode, such as Au, Ag, Cu, Pt, and aluminum, etc. is mentioned as an electrode used for the display layer lower part.

[0020] In the above, although the configuration of a display principle and a display layer and the production approach have been described next, the color display sheet using these display layers and a electrochromatic display are explained. An example of the block diagram of a color display sheet was shown in drawing 8 and 9.

[0021] In the display by the magnetic means of drawing 8 , on both sides of the above-mentioned display layer, a protective layer can be proposed to the up side and a base material and the configuration which combined the memory layer if needed further can be proposed at the bottom. From a viewpoint of visibility, the magnetic head and when [in real use / various] push and it is durable to ** and friction, transparency is high and a stable thing is used, for example, making a resin film and a resin plate rival, using [applying resin, or] them and performing writing/elimination from the upper part, since the thinner one is desirable, a protective layer is balance with said mechanical strength, and its about 10-1000 micrometers are still more desirable. Although a base material can use resin films, such as polyethylene terephthalate, a polycarbonate, and polyethylene, and a resin plate, it is not limited especially, and the thinner one is desirable [thickness] when it takes performing writing/elimination into consideration. On the other hand, when the ease of treating as a sheet is taken into consideration, a problem is too thin not much and its about 10-1000 micrometers are desirable. Although the memory layer is mainly made of the semi-hard magnetic material, it is for holding by magnetization of a memory layer and thickness is based also on the magnetic material and the production approach of using whether it cuts the field of writing of the display information written in by the magnetic means or a certain amount of magnetic field exists in an operating environment and, about 0.1-10 micrometers is desirable. The device of setting up the threshold of particle rotation, in order to hold display information if needed, when there is no memory layer can be considered.

[0022] In the display by the electric means of drawing 9 , it consists of the protective layer of the upper part of a display layer, and a lower base material, and the means of setting up the threshold of particle rotation if needed attains it for maintenance of display information. As other operation gestalten, the gestalt of constituting the electrode of the display layer upper part or/and the lower part in sheet circles is also considered. As for the part which carries out writing/elimination, in the case of a display sheet, it is possible to separate and to make only the amount of display become independent. Therefore, it becomes a display means by which various components can be dealt with like [it is light and] Kami by using flexible ingredients, such as plastic film.

[0023] As a means to input or eliminate image information on these display sheet, by the magnetic means,-dimensional [1] or a two-dimensional magnetic-head array is used from the display layer lower part, or it becomes possible from the display layer upper part with a magnetic pen etc. at a part of postscripts/elimination. In addition, in using a 1-dimensional magnetic-head array, it records the image of the whole viewing area using a means to move to a main scanning direction. Moreover, with an electric means, it is the approach of impressing electric field on both

sides of the display layer upper and lower sides corresponding to each pixel with an electrode. When the display sheet is separated from such a writing/elimination means, alignment will be carried out to these, it will connect, and it will perform writing/elimination.

[0024] The input section in which the electrochromatic display which is another operation gestalt of this invention performs writing/elimination with a display as shown in drawing 10 and 11 is united. In the case of this indicating equipment, it will be used as a display which fixed the installation to the above-mentioned display sheet having separated from the input section, and were able to treat as a display medium like Kami. In order not to separate a display from the case of a display sheet in things, it is not necessary to perform alignment of a display and the input section which performs writing/elimination, and becomes more advantageous to colorization.

[0025]

[Example] The polymer spherical particle with a particle size of about 6 micrometers which contained the ferrite particle as the [example 1] magnetic substance was produced by the well-known suspension-polymerization method. By applying poly BINIRI alcohol as an adhesive layer on a glass substrate, covering with the above-mentioned magnetic-substance content polymer spherical particle, fixing on this, and vapor-depositing aluminum from a top, aluminum was made to adhere to the particle upper part, and it magnetized with the electromagnet of 1KG continuously, the particle was removed from the adhesive layer, and the particle classified by color and magnetized in white / black 2 color was produced. Next, the microcapsule which connoted these rotation particle and the silicone oil by the coacervation method of well-known gelatin and gum arabic was produced. Next, these microcapsules were distributed in the color resist solution of R, it applied on the 100-micrometer polycarbonate film with the spin coat method, and patterning arrangement of the image display layer which consists of a matrix of R by the photolithography method was carried out at the position. Then, the image display layer which consists of a matrix of G has been arranged similarly, the image display layer which becomes the last from the matrix of B has been arranged, and the image display layer from which the color of a matrix differs periodically in a 100x100-micrometer pixel by about 15 micrometers in thickness was formed. On such an image display layer, the acrylic resin of a heat-curing mold was carried out with **, it carried out 150-degree-C 20-minute **-KU, the 100-micrometer protective layer was formed, and the sheet for color displays was produced. When this color display sheet was stuck to the 2-dimensional magnetic-head array and writing/elimination was performed, the color display by color mixture was possible.

[0026] Carbon black was kneaded with [example 2] Sun Wacks E-200 (Sanyo Chemical Industries make), it corned and classified by the spray dryer method, about 15-micrometer black particle was produced, and the particle which colored white the semi-sphere section by the same approach as an example 1, and was classified by white / black 2 color by color in this was produced. Applied on the glass substrate which carried out mixed distribution of these particles into NI acidity-or-alkalinity RTV rubber KE103/Cat103 (Shin-Etsu Chemical), and carried out patterning of the transparence electric conduction film to the shape of a stripe of 110-micrometer pitch (Line 100microSpace 10micrometer), and leave it for 18 hours, it was made to harden at 25 degrees C, and the silicone rubber layer containing about 100-micrometer rotation particle was formed. After having been immersed into the silicone oil, leaving this for 24 hours and taking it out, patterning coloring of the matrix section of an image display layer was carried out with the ink jet method at RGB. On such a display layer, the glass substrate which carried out patterning of the transparence electric conduction film to the shape of a stripe of 110-micrometer pitch (Line 100microSpace 10micrometer) was made to rival so that it may become the shape of an electrode and a grid of the image display layer upper and lower sides, and the electrochromatic display was produced. When electric field were added for this electrochromatic display with the electrode of the display layer upper and lower sides and writing/elimination was performed, the color display by color mixture was possible.

[0027]

[Effect of the Invention] According to invention of claim 1, it became possible to perform color display, without complicating a configuration by the wide-field-of-view angle and low cost

compared with LCD. According to invention of claim 2, the full color display in which visibility, such as brightness and contrast, was excellent conventionally was attained. According to invention of claims 3 and 4, the condensation between the particles in connection with image display was prevented, and the easy color display of a controllability became possible. According to invention of claim 5, the brightness and the advantageous color display in respect of contrast became possible. According to invention of claim 6, since the configuration was easy, production was easy and the color display excellent in visibility became possible. According to invention of claim 7, it is a wide-field-of-view angle, and the paper[of the still more nearly same configuration as a monochrome display]-like color display sheet was made. According to invention of claim 8, it is a wide-field-of-view angle, and the electrochromatic display of the still more nearly same configuration as a monochrome display was made. According to invention of claims 9-12, the manufacture approach of a color display sheet and a electrochromatic display producible by low cost has been offered.

[Translation done.]

* NOTICES *

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TECHNICAL FIELD

[Field of the Invention] This invention relates to the color display approach, a color display sheet, electrochromatic displays, and these manufacture approaches.

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PRIOR ART

[Description of the Prior Art] As the indicating equipment which displays information, and a display, CRT takes into consideration small, a light weight, a low power, etc. for it, although current [the viewpoint of the display quality and economical efficiency to] is the mainstream, and various flat-panel displays are done [research and development in them] and put in practical use. As these examples, light-receiving mold displays, such as luminescence mold displays, such as a plasma display (PDP), an electroluminescence display (ELD), a fluorescent indicator tube (VFD), and a light emitting diode (LED), and a liquid crystal display (LCD), are mentioned. Since it got used to a medium called printed matter and has so far been familiar with it in OA field which becomes in use in these applicable fields, it is difficult but to solve this point in luminescence mold displays including CRT in the present condition the place where the eye by flicker etc. is expected little display of fatigue. In that respect, although LCD of a light-receiving mold is advantageous at this point and there are also merits, such as a low power, further, the actual condition is that there are also characteristic demerits, such as an angle-of-visibility dependency and temperature dependence. Then, it had the image display layer which a light-receiving mold display also becomes from a microcapsule, and magnetic or the method of performing image display, for example, an electrophoresis display, the magnetic migration display, the particulate material orientation mold display, the particle rotation mold display using electric or a magnetic means, etc. have been proposed by changing the rate of a light reflex per pixel by the electric action. However, in the present condition, these are only monochrome monochromatic specification and had the big problem that color display was not put in practical use compared with said CRT and LCD. For this reason, when the cost rise by this using a color filter although the color filter of two or more colors is arranged on a display layer in JP,10-232630,A and color display is performed can be considered and a color filter layer is newly added further, lamination becomes complicated, a making process not only increasing but a display property (conspicuousness) is influenced, and it becomes still more disadvantageous also in the case of write-in elimination from the display layer upper part, and is not practical.

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EFFECT OF THE INVENTION

[Effect of the Invention] According to invention of claim 1, it became possible to perform color display, without complicating a configuration by the wide-field-of-view angle and low cost compared with LCD. According to invention of claim 2, the full color display in which visibility, such as brightness and contrast, was excellent conventionally was attained. According to invention of claims 3 and 4, the condensation between the particles in connection with image display was prevented, and the easy color display of a controllability became possible. According to invention of claim 5, the brightness and the advantageous color display in respect of contrast became possible. According to invention of claim 6, since the configuration was easy, production was easy and the color display excellent in visibility became possible. According to invention of claim 7, it is a wide-field-of-view angle, and the paper[of the still more nearly same configuration as a monochrome display]-like color display sheet was made. According to invention of claim 8, it is a wide-field-of-view angle, and the electrochromatic display of the still more nearly same configuration as a monochrome display was made. According to invention of claims 9-12, the manufacture approach of a color display sheet and a electrochromatic display producible by low cost has been offered.

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TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] Therefore, the purpose of this invention is realizing color display, without complicating a configuration to a monochrome display in the approach of performing image display, by changing the rate of a light reflex of the particle in an image display layer.

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MEANS

[Means for Solving the Problem] In the approach of performing image display by changing the rate of a light reflex of the particle in an image display layer, when coloring the image display layer and performing color display, the approach of performing color display with a configuration equivalent to the conventional monochrome display was found out. In this invention, full color ** becomes possible theoretically by arranging an image display layer periodically to three kinds, R, G, and B, respectively, and controlling an optical property by each pixel unit. here -- a pixel -- writing/elimination -- it is a controllable smallest unit. The endocyst of the particle to which the rate of a light reflex in an image display layer is changed especially is carried out into the microcapsule, and the particle to which the rate of a light reflex in an image display layer is changed when the matrix section which arranges these as an image display layer and is fixed is colored is held in the minute hole in an image display layer, and it is effective when the matrix section which forms the image display layer is colored. Moreover, in color display, although the fall of brightness takes place in order to carry out the spectrum of the white light, fewest particle rotation methods of the effect, i.e., the method of rotating the pivotable particle by which a means to change the rate of a light reflex of a particle was classified by two colors by color, are desirable. In this case, the roll control means of a particle has the desirable magnetic approach. And the color display sheet using such the method of presentation and the electrochromatic display which wrote in further or/and possesses an eliminable means are proposed. Furthermore, the approach of carrying out patterning arrangement of the image display layer of the color which changes as the coloring approach of an image display layer with photolithography methods using the photoresist which contained coloring matter on the occasion of the image display stratification, and especially the approach of carrying out patterning coloring with an ink jet method after the image display stratification found out the desirable thing.
[0005] Invention of claim 1 is the color display approach characterized by coloring an image display layer and performing color display in the approach of performing image display, by changing the rate of a light reflex of the particle in an image display layer. In the color display approach according to claim 1, invention of claim 2 is the color display approach characterized by performing color display, when patterning arrangement is carried out in each pixel unit at three kinds, R, G, and B, respectively and the color of an image display layer controls these rates of a light reflex by each pixel unit. Invention of claim 3 is the color display approach which the endocyst of the particle to which the rate of a light reflex in an image display layer is changed is carried out into the microcapsule, and is characterized by coloring the matrix section which arranges these as an image display layer and is fixed in the color display approach according to claim 1. Invention of claim 4 is the color display approach characterized by coloring the matrix section in which the particle to which the rate of a light reflex in an image display layer is changed is held in the minute hole in an image display layer, and forms the image display layer in the color display approach according to claim 1. Invention of claim 5 is the color display approach characterized by a means to change the rate of a light reflex of the particle in an image display layer being the approach of rotating the pivotable particle classified by two colors by color in the color display approach given in claim 1 thru/or any 1 term of 4. Invention of claim 6 is the color display approach that the roll control means of a particle is characterized by being the magnetic

approach, in the color display approach according to claim 5. Invention of claim 7 is a color display sheet which has the colored image display layer including the particle in which the rate of a light reflex is changed and it deals, and performs color display by the approach of claim 1. Invention of claim 8 is a electrochromatic display characterized by providing the means which has the colored image display layer including the particle in which the rate of a light reflex is changed and it deals, the optical property of a particle is changed, and writes in, or/and eliminates. Invention of claim 9 and claim 10 is the manufacture approach of the color display sheet to which the coloring approach of an image display layer is characterized by being the approach of carrying out patterning arrangement of the image display layer of a different color in claim 7 and claim 8 by the photolithography method using the photoresist which contained coloring matter on the occasion of the image display stratification, respectively, and a electrochromatic display. Invention of claim 11 and claim 12 is the manufacture approach of the color display sheet characterized by the coloring approach of an image display layer being the approach of carrying out patterning coloring with an ink jet method after the image display stratification in claim 7 and claim 8, respectively, and a electrochromatic display.

[0006]

[Embodiment of the Invention] The gestalt of operation of this invention is explained. An electrophoresis method is first described among the above-mentioned methods of presentation. The liquid which distributed the particle of light absorption nature or light reflex nature is connoted in a microcapsule. Or if enclose into an image display layer as it is, an electric double layer is formed of transfer of the charge in a solid-liquid interface, a particle is charged in forward or negative and electric field are added to this, in order that a particle may migrate according to the direction of electric field, An image is formed by giving the contrast of the light and darkness of the display layer upper part for every pixel.

[0007] The liquid which distributed the magnetic-substance particle of light absorption nature and the nonmagnetic particle of light reflex nature is connoted in a microcapsule, or it encloses into an image display layer as it is, if a field is added, a magnetic-substance particle will be attracted, and the magnetic migrating method forms an image by giving the contrast of the light and darkness of the display layer upper part for every pixel. The dispersion liquid of a magnetic-substance particle with shape anisotropy, such as flat nature, are connoted in a microcapsule, or it encloses into an image display layer as it is, if a field is added, reflection of the light according to the sense of a magnetic-substance particle with shape anisotropy, dispersion, and absorption will take place, and a particulate material orientation method forms an image by giving the contrast of the light and darkness of the display layer upper part for every pixel.

[0008] A particle rotation method is magnetic or a thing which forms an image by carrying out a roll control and giving the contrast of the light and darkness of the display layer upper part for every pixel with an electric means etc., about a rotation particle with the part from which the rate of a light reflex classified by by one half by color differs. A particle rotation method is effective as a method with least effect of a fall of the brightness according to colorization especially at this invention.

[0009] Therefore, a particle rotation method is hereafter explained to a detail. An example of the color display approach in this invention in the particle rotation display by the magnetic means was shown in drawing 1 and drawing 2 . When both do the roll control of the rotation particle 3 kicked by the color by the magnetic means (magnetic head 20) in each pixel unit as mentioned above to two colors of light reflex nature / light absorption nature, such as white/black, it writes in, or/and it eliminates, and in this case, the image display layer 4 corresponding to each pixel has the matrix section 5 colored a different color, and the color display of it becomes possible. In this case, it is required like drawing 1 to change into the condition that the rotation particle 3 is confined in the minute hole section in the image display layer 4 (hole 6), and a particle can be rotated like drawing 2 in connoting the rotation particle 3 in a microcapsule 10 with a fluid 2. By this magnetic rotation particle method, the rotation particle in the case of a monochrome display can be used as it is, and color display can be realized, without complicating a configuration. If the color of an image display layer is made into three kinds of RGB, R, G, B, and black can be expressed as it is, if all adjacent RGB is displayed, color mixture can express white, and the

expression of neutral colors is also attained in the combination of RGB. However, about gradation, it is difficult and it is realistic to make a pixel small and to perform area gradation what is depended on rotation condition. in addition, drawing 1 R> -- in 1 and 2, a sign 30 is a base material.

[0010] The microcapsule which connotes the rotation particle shown in drawing 1 is constituted from a rotation particle 3 kicked by the color by a fluid 2 and two colors in it with the outer shell 1, as shown in drawing 3 , and a rotation particle can rotate it now freely within a capsule. Although such magnitude is related to the ease of carrying out of the magnitude (resolution) of a display and a display pixel, dispersion of light, and manufacture etc., its about 1-1000 micrometers are practical. The rotation particle contains the magnetic substance, it is magnetized so that it might be classified by two colors by color, while N pole and another side may become the south pole in them, and it serves as a permanent magnet. It is a spherical particle which made resin, such as a spherical magnetic-substance particle or polystyrene, and polyethylene, contain the magnetic substance, such as iron, such as magnetite and a ferrite, cobalt, and nickel, a rotation particle has the gestalt which rotation of a particle and control of a halt tend to perform, and the desirable thing which is classified by color and is easy to manufacture, and since a thing of a configuration with uniform all and magnitude is desired, its spherical gestalt is substantially desirable. Specific gravity, chemical stability, etc. are still more important. Especially the magnetic substance / resin system particle can produce the monomer which distributed grinding or a magnetic-substance particle after kneading these using approaches, such as an emulsion polymerization, a suspension polymerization, and a distributed polymerization. In order to classify a rotation particle by color to light reflex nature and light absorption nature, black objects, such as coloring matter carbon of white systems, such as a titanium dioxide, are distributed to binder resin a solvent and if needed, and metals, such as electrochemical processes, such as spreading of a spray etc. and plating, or said coloring matter, and Au, Ag, aluminum, are colored by approaches, such as a spatter and vacuum evaporationo, etc. Moreover, in order to distinguish by different color with in two colors, embed a non-coloring field in adhesives and a resin layer, and it fixes, or is colored only a coloring side by floating into the liquid which adjusted a coloring particle and specific gravity etc. Since the color of the magnetic substance is almost black, when using black between two colors at one side in the case of a magnetic particle, since white is only colored another side and it can classify by color in two colors, it is convenient. In this invention, since the matrix section which forms an image display layer is colored, what was used by monochrome display can use the above-mentioned rotation particle as it is.

[0011] next -- as the ingredient which constitutes the outer shell of a microcapsule -- common resin, such as acrylic, an methacrylic system, polyester, polystyrene, poly urea, a polyamide, and epoxy, -- independence -- or it can mix and ******. As the manufacture approach of a microcapsule, the in-situ method which supplies a monomer from either the internal phase of an emulsion who distributed the interfacial polymerization which supplies a monomer, and a rotation particle, or an external phase, and other well-known microencapsulation techniques are used from both the inside of an emulsion which distributed the rotation particle, and an outside. Properties, such as a mechanical strength which, pushes and bears **, transparency, and chemical stability, are searched for, and the outer shell of a microcapsule can also be reinforced by surface treatment, such as covering a front face by various resin etc., etc. if needed. [a mechanical strength] A lubrication action for the fluid made to contain in a microcapsule to make rotation of a rotation particle smooth is called for most, and liquids, such as water, an oil, and alcohol, are mentioned.

[0012] Thus, the produced microcapsule is arranged, and although an image display layer with the matrix of a color which is different in each pixel unit is formed, the formation approach of this display layer is explained.

[0013] first, a pigment -- a color -- ** -- the photolithography method which distributed and used the microcapsule into the coloring photoresist containing coloring matter is mentioned as a desirable approach. This approach carries out arrangement immobilization of the photoresist colored R which distributed the microcapsule at a predetermined pixel according to a series of

FOTORISO processes of spreading, desiccation, exposure, and development, as shown in drawing 4 . Then, an image display layer with the matrix section by which patterning was carried out to RGB can be formed by carrying out arrangement immobilization of the microcapsule at a predetermined pixel using the photoresist similarly colored G and the photoresist colored B. Under the present circumstances, a color property etc. is controllable by the thickness of the photoresist layer which remains as the matrix section of an image display layer, the content of the coloring matter in a photoresist, etc. It is not limited especially although the negative resist which contained photopolymerization initiators, such as benzophenones and anthraquinone, to acrylate resin, the positive type photoresist which contained the esterification object of o-quinone diazide in novolak mold phenol resin are mentioned as a photoresist used for these, for example, and the mechanical endurance when becoming an adhesive property for fixing the dispersibility of a microcapsule and them and an image display layer etc. should be just excellent. Moreover, properties, such as flexibility, are searched for when using as a display sheet.

[0014] The coloring matter which mainly has the spectral characteristic in three primary colors as coloring matter made to contain for coloring to these is desirable, and inorganic pigments, such as organic pigments, such as a perylene pigment, a lake pigment, azo pigment, the Quinacridone system pigment, an anthraquinone system, metal replacement phthalocyanine pigment, and halogen multi-permutation phthalocyanine pigment, titanium oxide, ferrous oxide, cobalt purple, and cobalt blue, are mentioned.

[0015] In addition, as shown in drawing 5 , after forming an image display layer as a desirable approach, the approach of carrying out coloring patterning of the image display layer matrix section with an ink jet method is mentioned. The image display layer which consists of the matrix section which fills between a microcapsule and them by this approach by carrying out spreading desiccation of a photo-setting resin (photoresist), thermosetting resin, and the common binder resin solution, and stiffening the resin section with light or heat first if needed is formed. Although especially these resin that forms the matrix section is not limited, since it becomes an ink absorbing layer else [, such as the above-mentioned adhesive property, a mechanical strength, and flexibility,] in consideration of an ink jet method, for there to be ink competence, and to excel in dot repeatability, and to excel in transparency is desired. From such a viewpoint, the various resin of water solubility and a hydrophilic property is desirable, for example, the hydrolyzate of polyvinyl alcohol, polyethylene oxide, polypropylene oxide, a polyvinyl pyrrolidone, and a styrene maleic anhydride copolymer or its water-soluble salt, methyl cellulose, a hydroxymethyl cellulose, hydroxypropylcellulose, a carboxymethyl cellulose or its water-soluble salt, polyacrylic acid, or its water-soluble salt is mentioned. An ink jet method gives the ink of each color, for example, RGB, after forming an image display layer. Although the method by heat energy, mechanical energy, etc. is held as an ink jet method, it is not limited especially. Moreover, what is generally used as an object for ink jets can be used also about the ink to be used.

[0016] Other microcapsules are arranged and electrochemical processes, such as an electrodeposition process, etc. are mentioned as an approach of forming an image display layer with the matrix of a color which is different in each pixel unit. In this case, the conductive layer used as an electrode is needed for the part in which all form an image display layer. Therefore, although an electrode configuration which does not flow is needed between each pixel, the process of patterning arrangement of a microcapsule is made easily. Moreover, in the method of presentation by electric means to mention later, since an electrode is needed for a display drive, it can use as an electrode for a display drive as it is.

[0017] As shown in drawing 2 , it can shut up in the minute hole in an image display layer, and it not only carries out endocyst to a microcapsule like the above-mentioned explanation, but can also rotate a rotation particle. In order to perform such an operation gestalt, by embedding a rotation particle into an elastic body like silicone rubber, and making a fluid like a silicone oil permeate into silicone rubber, silicone rubber swells, a clearance is made between a rotation particle and silicone rubber, a silicone oil is filled there, and structure like drawing 2 is done. In addition, in order to embed a rotation particle into silicone rubber, a rotation particle is distributed in the liquefied silicone rubber before bridge formation, and it can attain by applying this and performing crosslinking reaction with vulcanization etc. as the shape of film.

[0018] In said explained approach, an ink jet method is suitable to color the matrix section in the case of the structure of drawing 2 . That is, after forming the image display layer of the structure of drawing 2, coloring patterning of the image display layer matrix section is carried out with an ink jet method like the case of the structure of drawing 1. In addition, in this case, the matrix section may be used for an ink absorbing layer as it is, and the various resin layers of the above-mentioned water solubility and a hydrophilic property may be prepared as an ink absorbing layer if needed.

[0019] Next, an example of the color display approach of the particle rotation display by the electric means was shown in drawing 6 and 7. The configuration of an image display layer and the formation approach are the same as that of the case of a magnetic means, a different point from a magnetic means is a particle with the electrification property that not the magnetic substance in which the rotation particle had two magnetic poles but the parts classified by two colors by color differ, and this can be produced by covering a rotation particle front face by matter different a semi-sphere every. That is, in case it classifies by color in two colors, a part with the electrification property that are a wrap reason by the matter by which colors differ a front face, and they usually differ as it is will be made. However, in fact, since it cannot necessarily contribute to particle rotation, particle rotation is attained by adding an ingredient which an electrification property is large and differ. The wax-like matter is well used for this from the ease of electrification control. As these examples, waxes, such as higher-fatty-acid metal salts, such as higher fatty acids, such as stearin acid, a palmitic acid, and a lauric acid, and aluminum stearate, higher-fatty-acid derivatives, carnauba wax, and paraffin wax, polyethylene, polypropylene, an ethylene-vinylacetate copolymer, etc. are mentioned. Moreover, dielectrics, such as a transparent silicone oil, are used for the fluid in the microcapsule of drawing 6, or the fluid which filled the inside of the minute hole of drawing 7. Furthermore, in the case of an electric means, the electrode by which patterning was carried out per pixel in the upper and lower sides of a display layer is needed. Under the present circumstances, although the upper part of a display layer needs to be a transparent electrode, there is especially such [the lower part] no limitation. Brightness can be improved by using an ingredient with the high rate of a light reflex rather. As a transparent electrode used for the upper part, well-known things, such as oxide-semiconductor thin films, such as In 2O3, SnO2, ZnO, CdO and TiO2, In2O3-Sn, and SnO2-Sb, are used. Moreover, it is not limited especially although a metal with gloss other than the above-mentioned transparent electrode, such as Au, Ag, Cu, Pt, and aluminum, etc. is mentioned as an electrode used for the display layer lower part.

[0020] In the above, although the configuration of a display principle and a display layer and the production approach have been described next, the color display sheet using these display layers and a electrochromatic display are explained. An example of the block diagram of a color display sheet was shown in drawing 8 and 9.

[0021] In the display by the magnetic means of drawing 8 , on both sides of the above-mentioned display layer, a protective layer can be proposed to the up side and a base material and the configuration which combined the memory layer if needed further can be proposed at the bottom. From a viewpoint of visibility, the magnetic head and when [in real use / various] push and it is durable to ** and friction, transparency is high and a stable thing is used, for example, making a resin film and a resin plate rival, using [applying resin, or] them and performing writing/elimination from the upper part, since the thinner one is desirable, a protective layer is balance with said mechanical strength, and its about 10-1000 micrometers are still more desirable. Although a base material can use resin films, such as polyethylene terephthalate, a polycarbonate, and polyethylene, and a resin plate, it is not limited especially, and the thinner one is desirable [thickness] when it takes performing writing/elimination into consideration. On the other hand, when the ease of treating as a sheet is taken into consideration, a problem is too thin not much and its about 10-1000 micrometers are desirable. Although the memory layer is mainly made of the semi-hard magnetic material, it is for holding by magnetization of a memory layer and thickness is based also on the magnetic material and the production approach of using whether it cuts the field of writing of the display information written in by the magnetic means or a certain amount of magnetic field exists in an operating environment and, about 0.1-10

micrometers is desirable. The device of setting up the threshold of particle rotation, in order to hold display information if needed, when there is no memory layer can be considered.
[0022] In the display by the electric means of drawing 9 , it consists of the protective layer of the upper part of a display layer, and a lower base material, and the means of setting up the threshold of particle rotation if needed attains it for maintenance of display information. As other operation gestalten, the gestalt of constituting the electrode of the display layer upper part or/and the lower part in sheet circles is also considered. As for the part which carries out writing/elimination, in the case of a display sheet, it is possible to separate and to make only the amount of display become independent. Therefore, it becomes a display means by which various components can be dealt with like [it is light and] Kami by using flexible ingredients, such as plastic film.
[0023] As a means to input or eliminate image information on these display sheet, by the magnetic means,-dimensional [1] or a two-dimensional magnetic-head array is used from the display layer lower part, or it becomes possible from the display layer upper part with a magnetic pen etc. at a part of postscripts/elimination. In addition, in using a 1-dimensional magnetic-head array, it records the image of the whole viewing area using a means to move to a main scanning direction. Moreover, with an electric means, it is the approach of impressing electric field on both sides of the display layer upper and lower sides corresponding to each pixel with an electrode. When the display sheet is separated from such a writing/elimination means, alignment will be carried out to these, it will connect, and it will perform writing/elimination.
[0024] The input section in which the electrochromatic display which is another operation gestalt of this invention performs writing/elimination with a display as shown in drawing 10 and 11 is united. In the case of this indicating equipment, it will be used as a display which fixed the installation to the above-mentioned display sheet having separated from the input section, and were able to treat as a display medium like Kami. In order not to separate a display from the case of a display sheet in things, it is not necessary to perform alignment of a display and the input section which performs writing/elimination, and becomes more advantageous to colorization.

[Translation done.]

* NOTICES *

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EXAMPLE

[Example] The polymer spherical particle with a particle size of about 6 micrometers which contained the ferrite particle as the [example 1] magnetic substance was produced by the well-known suspension-polymerization method. By applying poly BINIRI alcohol as an adhesive layer on a glass substrate, covering with the above-mentioned magnetic-substance content polymer spherical particle, fixing on this, and vapor-depositing aluminum from a top, aluminum was made to adhere to the particle upper part, and it magnetized with the electromagnet of 1KG continuously, the particle was removed from the adhesive layer, and the particle classified by color and magnetized in white / black 2 color was produced. Next, the microcapsule which connoted these rotation particle and the silicone oil by the coacervation method of well-known gelatin and gum arabic was produced. Next, these microcapsules were distributed in the color resist solution of R, it applied on the 100-micrometer polycarbonate film with the spin coat method, and patterning arrangement of the image display layer which consists of a matrix of R by the photolithography method was carried out at the position. Then, the image display layer which consists of a matrix of G has been arranged similarly, the image display layer which becomes the last from the matrix of B has been arranged, and the image display layer from which the color of a matrix differs periodically in a 100x100-micrometer pixel by about 15 micrometers in thickness was formed. On such an image display layer, the acrylic resin of a heat-curing mold was carried out with **, it carried out 150-degree-C 20-minute **-KU, the 100-micrometer protective layer was formed, and the sheet for color displays was produced. When this color display sheet was stuck to the 2-dimensional magnetic-head array and writing/elimination was performed, the color display by color mixture was possible.
[0026] Carbon black was kneaded with [example 2] Sun Wacks E-200 (Sanyo Chemical Industries make), it corned and classified by the spray dryer method, about 15-micrometer black particle was produced, and the particle which colored white the semi-sphere section by the same approach as an example 1, and was classified by white / black 2 color by color in this was produced. Applied on the glass substrate which carried out mixed distribution of these particles into NI acidity-or-alkalinity RTV rubber KE103/Cat103 (Shin-Etsu Chemical), and carried out patterning of the transparence electric conduction film to the shape of a stripe of 110-micrometer pitch (Line 100microSpace 10micrometer), and leave it for 18 hours, it was made to harden at 25 degrees C, and the silicone rubber layer containing about 100-micrometer rotation particle was formed. After having been immersed into the silicone oil, leaving this for 24 hours and taking it out, patterning coloring of the matrix section of an image display layer was carried out with the ink jet method at RGB. On such a display layer, the glass substrate which carried out patterning of the transparence electric conduction film to the shape of a stripe of 110-micrometer pitch (Line 100microSpace 10micrometer) was made to rival so that it may become the shape of an electrode and a grid of the image display layer upper and lower sides, and the electrochromatic display was produced. When electric field were added for this electrochromatic display with the electrode of the display layer upper and lower sides and writing/elimination was performed, the color display by color mixture was possible.

[Translation done.]

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is drawing for explaining the color display approach (microcapsule use) of a magnetic particle rotation display.
[Drawing 2] It is drawing for explaining the color display approach (minute hole use) of a magnetic particle rotation display.
[Drawing 3] It is drawing for explaining a microcapsule configuration.
[Drawing 4] It is drawing for explaining an example (FOTORISO law) of the image display stratification approach.
[Drawing 5] It is drawing for explaining example of another of the image display stratification approach (the ink jet method).
[Drawing 6] It is drawing for explaining the color display approach (microcapsule use) of a magnetic particle rotation display.
[Drawing 7] It is drawing for explaining the color display approach (minute hole use) of a magnetic particle rotation display.
[Drawing 8] It is drawing for explaining the example of a configuration of a color display sheet (magnetic means).
[Drawing 9] It is drawing for explaining the example of a configuration of a color display sheet (electric means).
[Drawing 10] It is drawing for explaining the example of a configuration of a electrochromatic display (the magnetic technique).
[Drawing 11] It is drawing for explaining the example of a configuration of a electrochromatic display (the electric technique).
[Description of Notations]
1 Outer Shell
2 Fluid
3 Rotation Particle
4 Image Display Layer
5 Matrix Section
6 Hole
10 Microcapsule
20 Magnetic Head
30 Base Material

[Translation done.]

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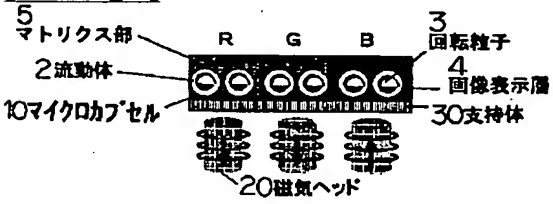
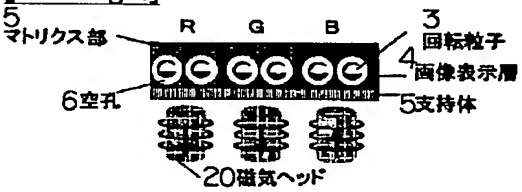
DRAWINGS

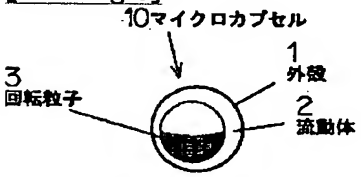
[Drawing 1]



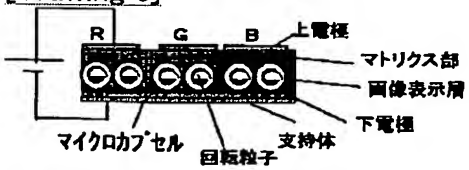
[Drawing 2]



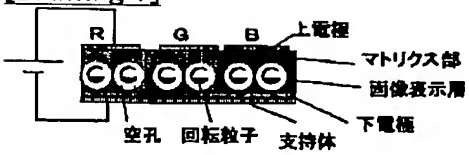
[Drawing 3]



[Drawing 6]

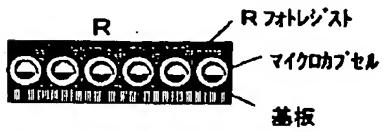


[Drawing 7]

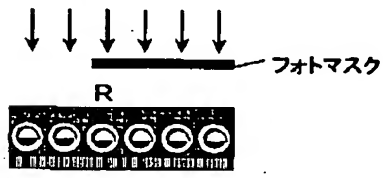


[Drawing 4]

(a) レジスト塗布



(b) 露光



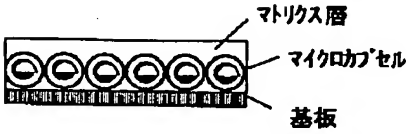
(c) 現像後、画像表示層形成（1色目）

(d) 以下、同様にして画像表示層形成（2色目）

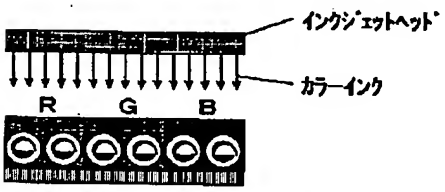
(e) 画像表示層形成（3色目）

[Drawing 5]

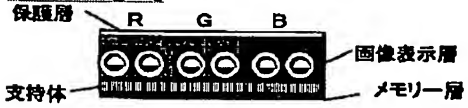
(a) マイクロカプセル／マトリクス層形成



(b) インクジェットによるマトリクス層着色

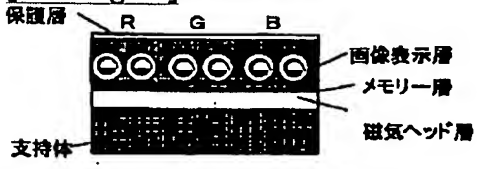


[Drawing 8]

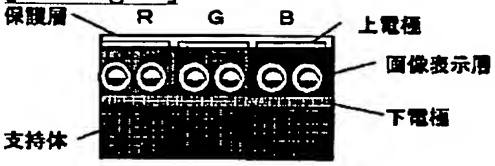


[Drawing 9]

[Drawing 10]



[Drawing 11]



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